A tick that feeds on birds may increase the range of Lyme disease

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Ixodes affinis adult female, dorsal view. Credit: Graham Snodgrass

If you have lived in the northeastern United States any time in the last 25 years or so, you have almost certainly heard of Lyme disease. You may have scrutinized odd-looking insect bites, wondering if they are developing the disease's tell-tale "bulls-eye" rash. And you may have become skilled at distinguishing blacklegged ticks (Ixodes scapularis), which can transmit the pathogen, from American dog ticks (Dermacentor variabilis), which cannot.

But, blacklegged ticks aren't the only tick species that plays a role in the

Lyme disease story. Researchers at Old Dominion University in Virginia are focusing on another tick, Ixodes affinis, that can also serve as a vector for Lyme disease. But don't look for this tick on your pant legs; I. affinis doesn't bite humans.

In their paper published in the *Journal of Medical Entomology*, "New records of Ixodes affinis parasitizing avian hosts in southeastern Virginia," Erin Heller and co-authors document I. affinis parasitizing five songbird species on which it had not previously been recorded. But why should we care about ticks on birds, especially if those ticks don't bite us? Because birds travel, sometimes very far, and they take their ticks and tick-borne pathogens with them.

Cases of Lyme disease are on the rise. According to the CDC, "Lyme disease is the most commonly reported vector borne illness in the United States." It is also on the move. While most commonly diagnosed in the northeast and upper Midwest, especially Wisconsin and Minnesota, Lyme disease is spreading geographically, especially into Virginia and the southeastern United States. The CDC estimates that about 300,000 Americans are diagnosed with Lyme disease each year, afflicting sufferers with flu-like symptoms. If not treated with antibiotics, the infection can cause inflammation of the joints and it can affect the heart and nervous system.

In order to understand the disease and its spread, you need to understand not only the bacterium that causes it, Borrelia burgdorferi, but also the ecology of the species that serve as its vectors and hosts. In the case of B. burgdorferi, the vectors that transmit the bacteria between hosts are ticks. Many species of animals are competent hosts for the bacteria, meaning that if they are bitten by an infected tick, the bacteria can reproduce in the animal and infect the next tick that bites it. Some species of mammal, especially the white-footed mouse (Peromyscus leucopus), and other animals, including some birds, are competent

reservoir hosts of B. burgdorferi.

Although I. affinis doesn't bite humans, it is the "primary maintenance vector" of B. burgdorferi in the southeastern U.S. Like the blacklegged tick, immature I. affinis feed on birds and rodents, and adults feed on larger mammals like deer. So while I. affinis can't infect humans with B. burgdorferi, it can spread it amongst the wild animal population and increase the reservoir of the pathogen.

Old Dominion University's "Tick Team," led by Dr. Holly Gaff, began monitoring ticks and tick-borne diseases in 2009. The team soon detected the invasion of I. affinis into southeastern Virginia and suspected that the ticks were moving into the area on birds. Robyn Nadolny, a doctoral candidate in the Gaff lab began investigating the northward range expansion of I. affinis. They recruited a newly hired professor, Dr. Eric Walters, whose research focuses on avian ecology, to help tackle the bird piece of the puzzle. Walters and graduate student Erin Heller set about capturing birds in mist nets four times per week, year round. Birds were checked for ticks, which were removed and frozen prior to identification.

While some species of ticks could be identified morphologically, such as rabbit ticks, others, especially engorged Ixodes species are "almost impossible to identify morphologically in their larval life stage," according to Walters. Graduate student Chelsea Wright sequenced DNA from the tick samples both to identify them to species, and to determine if they were infected with B. burgdorferi.

The researchers captured almost 2,000 birds and found only 12 parasitized by I. affinis. These twelve included one American robin (Turdus migratorius), one eastern towhee (Pipilo erythrophthalmus), one northern cardinal (Cardinalis cardinalis), one white-throated Sparrow (Zonotrichia albicollis), two brown thrashers (Toxostoma rufum) and six

Carolina wrens (Thyrothorus ludovicianus.) A total of 18 I. affinis ticks were collected from these birds, but only a single I. affinis was infected with B. burgdorferi.

Ixodes affinis was not the only species of tick found on the birds. Blacklegged ticks (Ixodes scapularis), the main vector of B. burgdorferi to humans, were also found on the birds, as were Amblyomma americanum, I. brunneus, I. dentatus, and H. leporispalustris. Ixodes affinis was frequently found co-feeding (simultaneously feeding on the same host) with other species of ticks. When ticks share hosts, it presents an opportunity for B. burgdorferi to move from one tick species to another.

Though this study found only a small percentage of birds were parasitized by I. affinis, it documented five species previously unknown to host this tick. According to lead author Erin Heller, it would not be unreasonable to expect that many other species of birds may be parasitized by I. affinis, especially those that forage or nest on the ground.

"These species spend more time in prime tick habitat, and therefore more commonly come in contact with ticks," she said.

Though I. affinis may feed more frequently on small mammals, the authors hypothesize that there may be certain habitats where birds may be very important hosts for I. affinis. Pine plantations in the south are frequented by many migrating birds, but have been shown to have relatively low abundance and diversity of small mammals.

More importantly, birds are highly mobile and some species migrate great distances. One of the species on which the researchers found I. affinis, the White-throated Sparrow, is migratory and travels north to breed in the Boreal forest of Canada and the upper Midwest and

Northeast of the U.S. Heller and co-authors mention a previous study by J.D. Scott et al. (2012) which documented I. affinis larvae and nymphs on a Swainson's Thrush (Catharus ustulatus) in Manitoba Canada. Swainson's Thrushes are long distance migrants that winter in Central and South America. Clearly birds have the potential to move ticks and tick borne diseases great distances.

The factors influencing the geographical range of ticks and tick borne diseases are diverse and complex. Climate change may play some part. Dr. Holly Gaff, a specialist in vector ecology and co-author of the study, says some changes "such as the expansion of blacklegged ticks into Canada are moving at a rate and direction that parallels climate change." But there may be other more important factors, including "habitat fragmentation, the population explosion of white-tailed deer, the loss of meso-predators, and increasing suburbanization."

As the range of I. affinis expands northwards and overlaps more with that of the human-biting blacklegged tick, the authors predict that having two competent tick vectors may increase transmission of the pathogen throughout the system and lead to an increase in the number of Lyme disease cases in humans.

This study is part of the larger, ongoing Old Dominion University tick surveillance project. The researchers plan to continue to collect and monitor ticks via flagging, small mammal trapping, and submissions from citizens handling wildlife—including hunters and wildlife rehabilitators. The researchers also hope to sample birds other than songbirds, such as gamebirds and domestic birds like chickens.

This study adds to a growing body of evidence that indicates that in order to understand the spread of Lyme disease, researchers must consider the ecology of all of its various hosts and vectors. Ixodes affinis and its various feathered hosts may prove to play a significant part in the

story of this potentially debilitating disease.

More information: "New records of Ixodes affinis parasitizing avian hosts in southeastern Virginia," jme.oxfordjournals.org/lookup/ … i/10.1093/jme/tjv175

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